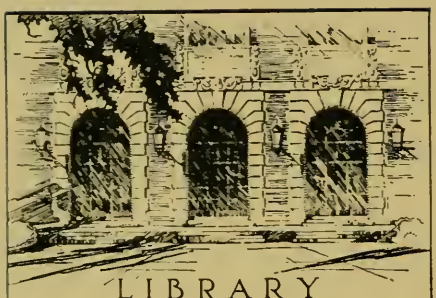

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WHY THE SHOE PINCHES

A CONTRIBUTION TO APPLIED ANATOMY.

EDINBURGH: PRINTED BY THOMAS CONSTABLE.

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Procrustes ante portas.

WHY THE SHOE PINCHES

A CONTRIBUTION TO APPLIED ANATOMY

BY HERMANN MEYER, M.D.,

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Translated from the German by

JOHN STIRLING CRAIG, L.R.C.P.E., L.R.C.S.E.

EDINBURGH:

EDMONSTON AND DOUGLAS.

MDCCCLXI.

PREFACE BY THE TRANSLATOR.

THE subject of the following pages may at first sight appear trivial, but I make no apology for having translated what so eminent an anatomist as Professor Meyer has thought fit to write.

Our ideas as to what is elegant and proper in regard to the feet being so radically bad, I have no hope that the promulgation of the proper shape of the shoe will have any sensible influence in reforming the fashions of the day.

There are, however, many who, having outlived the vanities of fashion, sigh for a little comfort did they only know where to find it; who for years have been exerting their ingenuity, and trying in vain, by means of lasts made for their feet, and various other expedients, to attain to the simple luxury of a comfortably fitting shoe, and these I am sure will feel thankful for the information now afforded them.

Parents, too, may be induced to see that the feet of their children are not made deformities before they are fully developed; and I believe that a great boon would be conferred by the introduction of the proposed shape of

accidents, and like causes, weakened parts are more susceptible to its influence," and then mentions cases in which first attacks, instead of appearing in the usual seat were limited to the knee or other parts that had suffered from previous injuries. At page 354 he remarks, that " the metatarso-phalangeal joint is one which is subject to pressure and injury *from having to support the weight of the body,*" and he adds, thereby affording impartial evidence as to the evil effects of an improperly shaped shoe, that he has, in many individuals who had never experienced any symptoms of gout, " very commonly found distinct evidence of injury on the surface of the cartilage, both of the head of the metatarsal bone and of the cup-like cavity of the phalanx." All this clearly points to a weakened part, and the merit of our author is in directing attention to the true cause of its production, for the metatarso-phalangeal joint is not, as Dr. Garrod says, actually injured by having to support the weight of the body, but by its having to do so in a constrained and unnatural position.

I may add, what must be well known to most professional readers, that Professor Meyer is the most recent and approved authority on the structure and mechanical adaptations of the foot and lower limbs. His researches on standing, *Das aufrecht Stehen,* (*Erster und zweiter Beiträge zur Mechanik des Menschlichen Knochengerüstes*), and on the knee-joint, *Die Mechanik des Kniegelenks,* ap-

peared in Müller's *Archiv* in 1853, and have since been incorporated in the *Lehrbuch der physiologischen Anatomie*, published by our author in 1856, where also will be found his account of the mechanism of the foot (p. 133 *et seq.*) Knowing, from statements made in his public lectures, and also from his recommending to his students the study of Professor Meyer's Physiological Anatomy, the high value set on these researches by Professor Goodsir of Edinburgh, I have submitted my proof-sheets to him, and am glad to be able to make use of his name as a guarantee for the correctness of my rendering of Professor Meyer's anatomico-physiological details; and I take this opportunity of acknowledging my obligations to my friend and former teacher for much valuable advice, and especially for the following expression of his opinion, which he has kindly permitted me to insert here:—

"The simplicity of the principles inculcated in Professor H. Meyer's work on "The Correct Form of Shoes" impresses the intelligent reader with confidence in their importance and applicability. Their simplicity consists in their scientific character. The author of the work has largely contributed to that recent rapid advance of anatomy and physiology which is due to the employment of more direct and refined methods of investigation. By his researches, more particularly into the structure and actions of the lower limbs, he has given to our conceptions in this department of the science a precision which

could only have been attained by the physico-mathematical method of investigation which he employed. The value of his results can only be properly estimated by the anatomist and physiologist ; but his practical application of certain of them in the work which you have rendered so successfully in English, cannot fail to be fully appreciated by the general reader."

In conclusion, I have to thank Professor Meyer for his courteous consent to my undertaking this translation, and for the additions with which he was kind enough to favour me. I have also to express my obligations to his publishers, Messrs. Meyer and Zeller of Zürich, for allowing me to have the woodcuts used in the original.

Stratford-on-Avon, *July* 1860.

PREFACE BY THE AUTHOR.

The greater part of the following pages appeared, in the spring of 1857, in the second volume of the "Monatschrift des wissenschaftlichen Vereinschrift in Zürich," under the title of "Procrustes ante Portas! Ein Culturgeschichtliches Zeitbild." As its title indicates, this paper was a pretty sharp satire on the many deformities which, through vanity or ignorance, have been thoughtlessly or intentionally inflicted on our bodies. On various occasions I have briefly alluded to evils of this kind, and dwelt more particularly on the errors in the usual form of the coverings of our feet, at the same time giving hints how a more suitable shoe might be obtained without prejudice to the ever-primary consideration of elegance. My attention had been directed to the subject in the following manner: On the one hand my experiments on the mechanism of walking, published elsewhere, led me to remark how utterly bad our foot-clothing is; and on the other, my position as a teacher of anatomy gave me abundant opportunities of observing the almost incredible deformities

of the human foot, resulting from the pressure of the shoe. Several well-marked cases having come under my notice in rather rapid succession, I wrote the paper above alluded to, to make known, once for all, my opinions on the subject.

The matter excited much attention amongst those who had the opportunity of seeing this paper, and many medical men recognised, with great interest, the importance of the question involved. From the most varied sources I have since been urgently requested to recast this essay in a separate form, so that its contents might become known to a still wider circle of readers.

I confess having hesitated somewhat to comply with these demands. My scruples were overcome, however, by a consideration of the great importance of the subject, and I yielded the more readily that anatomists so distinguished as Peter Camper and Sömmering had preceded me with similar lucubrations,—the former with his paper "On the Best Shoe," and the latter with a treatise "On Stays." Moreover, it especially behoves anatomists to speak out on such subjects, since, from the nature of their studies, they have at hand the proper material for settling such questions.

The subject treated of by Sömmering concerns only one half of mankind; and of this half, only those who are sufficiently foolish voluntarily to sacrifice comfort, health, and beauty to an absurd fashion

In the case of the shoe, however, all mankind are equally interested; and the ventilation of the subject is the more important that we submit in ignorance only, and do not voluntarily subject ourselves to those injuries to health, and, it may be added, to temper, directly and indirectly inflicted by badly-shaped shoes.

Camper, writing on this subject in the last century, very truly remarks—"All horse-doctors and horse-fanciers are interested in the shoeing of their horses, numerous papers appear thereon, and shall we not concern ourselves about the foot-gear of man?"

Camper's suggestions attracted considerable attention, but his plans found little or no encouragement, because they were so very impracticable, and, above all, because of the very clumsy form of shoe he recommended.

May my little work be found more practical! I have, at all events, tried to produce a form in unison with the claims of elegance, and various trials have proved that my plans may be carried out with success.

HERMANN MEYER.

Zurich, *December* 1857.

WHY THE SHOE PINCHES.

What the Object of a Covering for the Foot is, and what Conditions this has to fulfil.

We put on shoes for precisely the same reason that we wear clothes on other parts of our bodies, namely, that we may be protected from injurious external influences.

The influences from which we desire to be protected are roughness of the ground on the one hand, and cold and wet on the other.

When the roughness of the ground only is to be provided against, the sandal—consisting of a sole of stiff leather or wood, fastened by thongs or bands so as completely to cover the underpart of the foot—is sufficient.

But if protection from cold and wet be also desired, the sole has generally added to it a covering for the whole foot, and part of the leg. This covering may be made of various stuffs, but usually consists of soft leather. When thus combined with the sole, the upper leather further serves to keep the sole firmly fixed under the foot, and thus does away with the need of bands and thongs. Such

combinations of upper leather and sole are called boots, shoes, etc.

A shoe, then, has to afford protection against unequal and rough ground, as well as against cold and wet. This is the object of a covering for the feet.

A covering for the foot has, however, to fulfil this object in a manner that will give rise to no disadvantage, the existence of which would essentially diminish the benefits of protection. The remedy would in this case be worse than the evil. Here, however, Fashion, so unfortunately mixed up in all our clothing-relations, steps in and must even have her say on the shape of the shoe. So long as the influence of fashion is confined to the cut and amplitude of the coat, the form and colour of the hat, and the like, the only harm that accrues is the probable production of a somewhat ludicrous effect. It signifies little, so far as health is concerned, whether a man wears a gray coat or a brown one, but it is of some importance whether the shoes he wears be broad or narrow, rounded or pointed, long or short. The shape of the shoe has too much influence on health and comfort to be left to the dictates of fashion.

The influence of fashion on the shape of the shoe produces the most baneful effects on the mechanism of the foot and on its soundness, and thus materially affects our moving about, and our consequent ability to take a sufficient amount of open-air exercise.

It is quite clear that the foot must get inside the shoe, and if the shoe differ in shape from the foot, it is no less plain that the foot, being the more pliable, must of necessity adapt itself to the shape of the shoe. If, then, fashion prescribes an arbitrary form of shoe, she goes far beyond her province, and in reality arrogates to herself the right of determining the shape of the foot.

But the foot is a part of the body, and must not be changed by fashion; for our body is a gift, and its several parts are beautifully adapted for the purposes for which they were intended. If, therefore, we in any way change its normal form, not only do we not improve, but we actually disfigure it. Of this truth many a lady must be painfully aware who has not been able to resist the temptation to lace herself into what is called a "fine figure;" and he too must know it who has permitted his feet to be remodelled by fashionable boots.

We do not indeed at first sight fully perceive the arrogant absurdity of which fashion is guilty in going so far as to determine the shape of our feet, because we are not alive to the fact that the case is peculiar to the feet. We only see it influencing the shape of the *shoe*, and come to the conclusion that it may regulate this as well as the cut of the coat. To this prevalent opinion we yield, regardless of the influence on the shape of the *shoe*, and thereby on the *foot*. As well indeed might Fashion one day come to the conclusion that fingers are inelegant, and

decree that henceforth the hand be squeezed into a conical leather bag;—as well indeed might she in one of her freaks forbid the display of our arms, and bind them firmly to our bodies like those of children in swaddling-clothes.

The shoe ought to protect the foot, but it has no business to distort its shape.

Shoemakers should be aware of this, and try to make the covering of the foot a suitable one. The best of them, however, are grievously ill-qualified for this task if they are ignorant of the principles on which they ought to proceed in the construction of shoes really fit to serve their purpose, or if, from thoughtlessness or timidity, they stick fast to the pernicious forms in general use. To those amongst their number who think for themselves, and who understand their business, the following hints on the proper construction of the shoe will be welcome.

A shoe which will really be a help to walking, and not, as is too often the case, a hindrance, should be adapted to the shape of the foot, and this must accordingly first occupy our attention.

On the Structure of the Foot.

The foot consists of six-and-twenty bones, very beautifully arranged, and admitting of more or less motion on one another.

Fourteen of these bones belong to the toes, the remaining twelve enter into the formation of the tarsus and metatarsus.

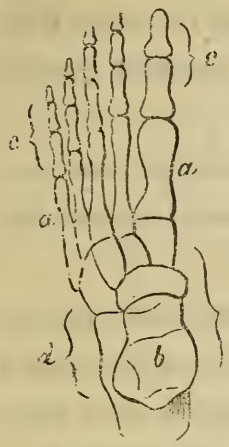

Fig. 1.

The metatarsal bones are the five long bones (*a*). With the forepart of these the toes form joints. The remaining seven are the tarsal bones, and one of these, the *astragalus* (*b*), is embraced on each side by a projection (*malleolus*) from the bones of the leg, thus forming the ankle-joint.

If the inner aspect of the foot is examined, we find that it is an arch,

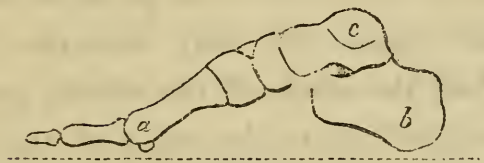

Fig. 2.

resting in front on the anterior heads of the five metatarsal bones (*a*), but principally on that of the great toe, and, on the *calcaneum* or heel (*b*) behind. The *astragalus* (*c*) forms the key-stone of the arch.

The arch is enabled to retain its form by means of strong ligaments or bands passing from one bone to the others; and, thus held closely together, sustains the superincumbent weight of the body without giving way.

When we rest on the foot, as in standing, the arch is

flattened by the pressure from above; and, consequently, becomes lengthened. When, however, the foot is allowed to hang free, the curvature of the arch is increased. At every step in walking also, when the foot is raised from the ground, the curvature immediately becomes greater through the action of the muscles.

The toes lie in front of the metatarsus, and are connected with it by joints. Each of the smaller toes has two joints,—the great toe only one.

The great toe plays by far the most important part in walking; because, when the foot is raised from the ground with the intention of throwing it forwards, we first raise the heel, then rest for a second on the great toe, and in lifting this from the ground the point of it receives a pressure which impels the body forwards. Thus, in raising the foot, the whole of the sole is gradually as it were "unrolled" up to the point of the great toe, which again receives an impetus by contact with the ground. The great toe ought therefore to have such a position as will admit of its being unrolled in the manner described; that is to say, it must so lie that the line of its axis, when carried backwards, will emerge at the centre of the heel; and this is its position in the healthy foot. The sole of an almost sound foot is given in Figure 3, and the true position of the great toe is indicated by the dotted line. This relation is still better brought out in Figure 4, which represents

the well-preserved foot of a child about two years old. The line drawn through both figures is that in which the

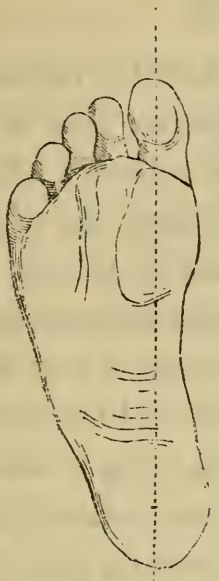

FIG. 3.

FIG. 4.

foot *unrolls* itself from the ground. The smaller toes, however, are by no means without their uses. In standing they rest on the ground, and give lateral support to the foot; while, in walking, they are bent in a peculiar manner, so that they are firmly pressed against the ground,—and here, too, they support the foot laterally. The first joint is strongly bent upwards, while the second is hollow above. This peculiar curvature enables the toes in a measure to lay hold of the ground as with birds' claws.

On the Construction of the Sole of the Shoe in the ordinary way.

In proceeding to make a shoe to order, the shoemaker measures the foot at various points; but of all the measurements he takes, none have a decided influence on the shape of the sole except the length, and perhaps the circumference of the foot at the root of the toes.

The length, however, is in all cases the more important, and in proceeding to plan out the sole, it is laid out in a straight line, a little is added to it, and the sole receives one of two shapes, according as the shoe is intended to fit the right or left foot, or either foot indiscriminately.

If the shoe is intended to be used for either foot, the line alluded to forms the centre round which the outline of the sole is symmetrically constructed, as in the accompanying Figures 5 and 6. The straight boundary line in front of the heel forms a right angle with the middle line.

If, however, as is more usual, the shoes are made for the right and left foot respectively, the outline of the sole corresponding to one foot only (Fig. 7), then the construction of the sole and heel is precisely the same as before; and the only difference is in that intermediate part called by shoemakers "the waist." The outer line of this waist is curved outwards, especially in

its anterior part; whilst the inner line also takes an outward direction. The "waist" between the heel and the sole is thus curved outwards, whilst in a straight

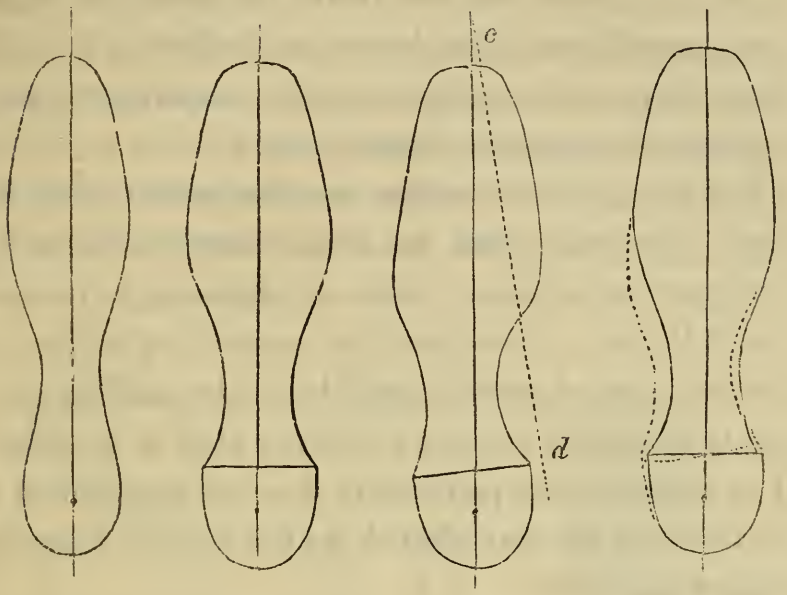

Fig. 5 Fig. 6. Fig. 7. Fig. 8.

shoe it is perfectly symmetrical. The straight line in front of the heel forms a right angle with the beginning of the curve. The two kinds of sole, although apparently different, are essentially the same, as is made clear by reference to the adjoining Figure (8), in which the one sole is laid over the other.

The point of the sole may be made broad or narrow, as fashion dictates.

How Shoes with Soles constructed in this way press the Foot out of Shape.

If we compare the sole of the usual construction with the actual form of the foot, it will be found that, apart from its smallness, it has deviated entirely from the form of the foot, as will readily be seen by comparing the soles represented above with Figures 3 and 4.

In making this comparison, we also perceive how the foot is injuriously acted on, since it must be forced, by the upper leather, into a shape corresponding to the outline of the sole. This cannot be avoided, indeed, for the toes are squeezed together from both sides, and the pressure is necessarily greatest where the shoe is narrowest. If we examine more particularly as to how the position of the toes is in this way affected, we find that the following changes take place.

From the outside the four smaller toes receive a pressure which forces them against each other, and also against the root of the great toe, which is thus pushed inwards.* The point of the great toe is besides pressed outwards, and the middle line, or axis, of the toe thus becomes oblique. This obliquity of the great toe thus results from the inward pressure on the root by means of the smaller toes, and the outward pressure on the point directly inflicted by the upper leather.

* The terms *outwards* and *inwards*, here and throughout, when used in reference to the foot, have relation to the middle line of the *body*, and not to that of the foot.

The distortion which thus arises in the foot is very important, for the almost rectangular triangle in which the toes naturally lie, is converted into an isosceles acute-angled triangle, and in this the toes are expected to find place. It is well if they can do so side by side, but this treatment is constantly giving rise to the most mischievous distortions, at first only manifested while the shoe is worn, but eventually becoming permanent. The accompanying outline (Fig. 9) represents a foot disfigured in this way;

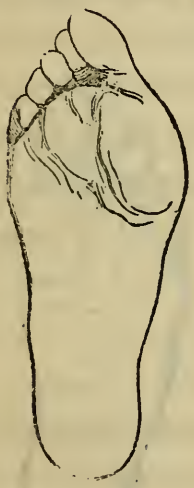

Fig. 9.

Fig. 10.

Fig. 11.

it was drawn from nature, and with the exception of this distortion is perfectly sound; it is the foot of a comparatively young woman. Figure 10 exhibits the outline of this sole laid over the sole of a corresponding shoe; whilst Figure 11 represents the skeleton of a foot reduced to this condition.

Very frequently, however, the toes cannot find place side by side, but, cramped for room, are pushed over one another, and this position gradually becomes habitual. The adjoining Figures, 12 and 13, taken from otherwise perfectly sound feet, are examples of this. The second toe is here pressed upwards above the great toe, and is thus only partially seen in looking at the sole of the foot. But we also occasionally find one of the other toes displaced, and I have frequently observed the small toe lying transversely across the backs of the others

FIG. 12.

FIG. 13.

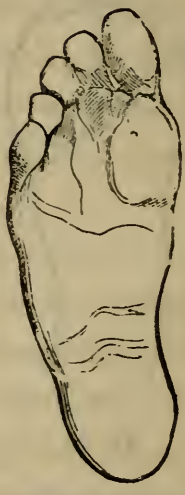

FIG. 14.

In both cases it very constantly happens that, in addition, one or more of the smaller toes are compelled to lie bent up, so that the first joint resembles a knob. This defect also becomes permanent.

It is clear that all these evils must become much greater if, in addition to its otherwise unsuitable shape, the shoe is made too short, since in this case the point of the great toe receives an additional backward pressure, which forces it still more against the smaller toes, and displaces its root still further inwards.

Such very marked distortions as are represented in the figures above are certainly not very frequent, yet they occur much oftener than we should expect. That even apparently healthy feet are not quite free from traces of these deformities is exemplified by Fig. 14, which at the first glance seems to be perfectly sound; on trying to draw on it the line seen in Figs. 3 and 4, we shall discover, however, that even here the great toe is directed obliquely outwards.

How the Shoe gets Trodden on one side.

The first consequence of the existence of such an unnatural relation between the sole of the shoe and the sole of the foot, is that the foot, especially while on the ground in walking and standing, exerts a counter-pressure on its covering. The upper leather is thus to a certain extent compelled to take the natural form of the foot.

With dry and hard upper leathers this modelling process is slow and gradual, but with flexible materials the change takes place rapidly. Aware of this, we never put

on our best shoes in rainy weather, because they would very soon lose all pretensions to elegance by acquiring the form of the foot, which as we have seen is very different from the shape of a fashionable shoe.

Since, then, the structure of the foot is such that the point of the great toe, the middle of its root, and the central point of the heel, lie in one straight line, it is natural that the upper leather should assume a shape in which the reciprocal relation of these three points can be maintained; and this shape is actually obtained in one of the two following ways:—

Either the point of the great toe pushes itself into a continuation of the line which can be drawn through the centre of the heel and its own root, and in this case the upper leather is pressed over the inner edge of the front of the sole:

Or (and this is more usual) the heel moves its centre into the line which can be drawn through the length of the great toe, and then the upper leather is forced over the inner edge of the heel.

In either case the shoes are said to be trodden on one side; and about this we grumble, while in truth this *treading on one side* is in reality a treading straight, the result of a victory gained by ill-used nature over unnatural constraint.

These two methods of treading on one side are the only examples of it which occur in walking with sound and

properly-formed feet; and hence they are frequently met with. That wearing down of the posterior edge of the heel which is so common, is caused, not by treading on one side, but by putting the heel to the ground first.

On the Prevention of Treading on One Side, by changing the Shoe from one Foot to the other.

Some recommend, with a view to the prevention of treading on one side, especially in the case of children, whose feet, retaining their normal form, readily twist their shoes about, that there should be a frequent change of shoes from the right foot to the left, and *vice versa;* and certainly the disfigurement of the shoe, by treading to one side, is thus prevented.

The foot has now, however, assigned to it the very serious task of treading the shoe to both sides, for it is clear that it is continually being opposed to the powerful pressure of the upper leather, which at every moment is being forced into another shape.

The changing of the shoe from one foot to another is thus one of the most baneful abuses to which a foot can possibly be subjected; and in the case of children (to whom these remarks only apply) with feet, the development of which is still incomplete, the influence must be doubly injurious.

How an improper form of Sole injures the Foot.

The consequences resulting to the foot itself from an improper form of sole, are not limited to the fact that the deformity becomes permanent, but are of a still more serious and important nature.

These more important evils are caused partly by the pressure to which the toes are exposed, and partly by the bad usage to which the distorted foot is necessarily subjected in walking.

The pressure of the upper leather first affects the small toe, and pushes it from before backward, bending it up on itself, and in this position it has not only to sustain the pressure of the upper leather generally, but also the pressure of the great transverse wrinkle which forms on it at the roots of the toes. Besides, as joints are exceedingly sensitive to external forces, it naturally happens that the joints of this toe frequently become subject to inflammation, giving rise to much pain and difficulty in making use of the foot, and at last leading to anchylosis (union of the bones forming the joint). The damage thus done to the efficiency of the foot is indeed not only very important, but before this point is reached much suffering must be endured, and we ought not, unnecessarily, to bring on ourselves any mutilation, be it ever so slight.

It is on the great toe, however, that by far the greatest and most serious evil is produced by an improper form of

shoe, and the influence is first felt on those two points which primarily receive the pressure or its immediate consequences, *i.e.*, on the point and root.

At the point of the great toe the pressure falls in the first instance on the nail, and on it therefore its greatest effects are experienced. This pressure principally affects the anterior part of the inner edge of the nail, and must, since it forces this part outwards (towards the smaller toes), displace the whole nail from its natural position. It first becomes oblique in its direction, and is then forced over the margin of the skin which ought to cover it on the side next the small toes, and thus slight inflammations (Fig. 16, *a*) are constantly excited in the displaced fold of skin, giving rise to more or less pain.

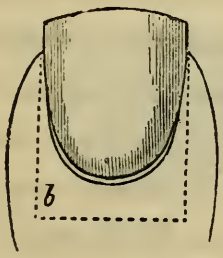

Fig. 15.

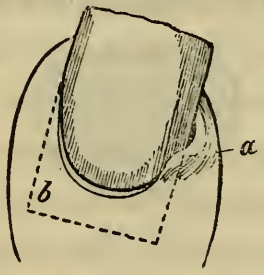

Fig. 16.

At the same time the matrix of the nail fixed under the skin (Figs. 15 and 16, *b*) is forced more firmly into the skin, whilst exactly on the point into which it is so pressed, there is constant pressure of the upper leather from above, and the nail can thus only be disposed of by

being rolled up on itself. This pressure, moreover, acts on the whole inner margin of the nail, which must therefore also be rolled up on itself. The whole inner margin is in this way bent downwards, and in consequence of such distortion the skin, in standing and walking, is continually pressing against the sharp edge of the nail, and is thus kept in a state of constant irritation. As the evil proceeds, the margin of the nail passes more and more round, and presses more sharply into the skin, until it reaches that state in which it becomes painful whenever a shoe is put on, because not only is the nail now driven into the skin by the pressure from under, in walking and standing, but precisely the same effect is brought about by the pressure of the upper leather, even when the foot is hanging quite free.

FIG. 17.

FIG. 18.

In this manner the skin which is contiguous to the bent-up margin of the nail is always irritated and painful, especially after prolonged walking; by degrees it gets into a state of chronic inflammation, and may eventually become ulcerated, producing what is popularly known as "proud flesh." We have here the figure of a "*growing-in nail*," an ailment which not only interferes

greatly with the use of the foot, but too often requires for its relief medical and even operative interference.

Not less important are the evils arising at the root of the great toe from the same cause. It has already been stated that the pressure of the upper leather pushes the point of the great toe against the smaller toes. The joint at the metatarsal bone thus becomes bent aside (Fig. 11), so that it forms a protuberance on the inner side of the foot. If the point of the toe is now pressed against the ground in walking, this protuberance must be made still greater, and so pressed more forcibly against the upper leather. At the same time, moreover, the great transverse wrinkle in the upper leather—the result of the bending of the toes—presses directly on the same point; and the protuberance at the root of the toe is thus constantly subjected to a twofold and very injurious pressure. In these circumstances it is by no means wonderful that this joint becomes subject to continual inflammation, which, by extending to the bones, must, in this situation, produce permanent and painful swellings, which become in their turn, and even from slight causes, the source of inflammations and new growths of bone.

In this manner arise those unseemly and painful swellings at the root of the great toe, which, either from mistaking their true nature or from wilful deception, are called *chilblains* or *gout*, just as the one or the other term appears the more interesting. In many cases, moreover,

Fig. 19.

this kind of inflammation of the bones, and their investing membrane, may lead to the formation of matter, and eventually to the disease known as *caries* or ulceration of the bone.*

Such are the principal injuries to the foot resulting from the pressure of ill-constructed shoes, and they are of sufficient importance to induce me to confine my remarks to them alone. I shall therefore only very briefly allude to the constant irritation which the pressure of such a shoe occasions to the skin, giving rise to the proverbially sensitive *corns*, and to those painful thickenings of the skin usually known as *bunions*.

I must, however, explain at somewhat greater length how the improper form of the shoe becomes one of the chief causes of *flat-foot*.

Flat-foot is occasioned by the loosening of the ligaments that knit the foot firmly together, and by the consequent sinking of the arch, the inner aspect of the foot no longer presents the natural hollow in the sole. The causes of such loosening of the ligaments are numer-

* In connexion with this I wish to explain, that I by no means desire to question the existence of such inflammations of this joint as are commonly attributed to gout; in by far the greater number of cases, however, inflammation of the metatarso-phalangeal joint of the great toe is traumatic, as above described; and even with regard to the occurrence of *gouty inflammations*, the causes above alluded to give an obvious reason for the formation, at the points indicated, of a *locus minoris resistentiæ*.

ous; but by far the most frequent, and one readily induced by the ordinary shoe, is weight improperly directed on the arch. If, for example, a shoe happens to be trodden on one side, and especially, as is most commonly the case, if it be so at the heel, then the heel has no support except from the inner margin of the sole, which is thus worn away, and the heel-piece becomes oblique, or, in other words, lower at one side than the other. In walking and standing on such a heel-piece, the whole external margin of the foot is raised, and the inner, which naturally supports the arch, is so depressed as gradually to lose its convexity; and thus flat-foot is induced.

Growing-in nails, unseemly protuberances at the base of the great toe (*gout, chilblains*), *corns*, *bunions*, and *flat-foot*, are thus the immediate consequences of that unsuitable form of the shoe in established use.

How the Shoemaker, with the best intentions, renders still worse the condition of the disfigured Foot.

When about to make a shoe for a foot already crippled, the shoemaker believes that he succeeds perfectly if he makes it exactly to fit the foot. This, however, is a gross fallacy; by so doing he renders the existing evils still greater.

A foot with its great toe lying obliquely is necessarily shorter than it would be with the toe in its proper posi-

tion, and if the shoemaker calculates the length of the sole by that of the measured length of the foot, he makes the shoe too short. In such a shoe there is no possibility of the great toe ever attaining its true position; on the contrary, it is still more firmly fixed in its false direction, and all the consequent evils are thus intensified.

In order that the shoe may not pinch, the shoemaker is also in the habit, with the very best intentions, of making the upper leather very roomy towards the inside opposite the projecting ball of the great toe. This expedient, however, as will readily be perceived, has the great disadvantage of affording still greater facility for the further displacement of the root of the great toe.

Thus when the shoemaker flatters himself that he has made a very comfortable and particularly *good fit*, it turns out that he has actually increased the distorting pressure on the great toe, and thus favoured the exciting cause of the whole mischief.

On very broad Shoes, and on taking Measure by means of an outline of the Foot.

Numerous examples have already shown us that the ordinary covering of the foot has many disadvantages; many attempts have accordingly been made to overcome these evils in one of these two ways:—

1. By making the shoe very broad;

2. By taking measure by means of drawing the outline of the foot on a sheet of paper.

Both methods are quite insufficient, as may readily be proved.

The results arising from a very broad shoe, in which, in addition to a correspondingly wide upper-leather, the sole is made unusually broad in front, can only be clearly understood by reference to the adjoining woodcut. In this we have a straight sole without any pointing before; but even with a sole of this kind the great toe cannot find a place in its true position, that is to say, in the line *a b*. It still remains pressed obliquely outwards, passing indeed in the line *c d*. Shoes of such a breadth of sole, which according to the current belief are faultless, are doubtless better, but are scarcely more suited to their purpose than shoes of the ordinary make. (Compare Figure 7, in which the line *c d* is likewise drawn, showing the position given to the great toe in the shoe.)

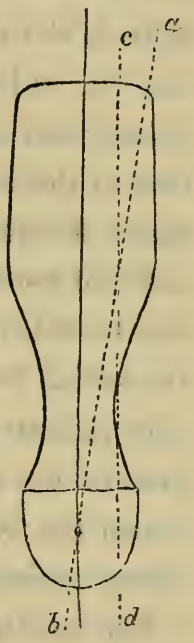

FIG. 20

The second method, that of measuring the foot by drawing its outline on a sheet of paper, is especially clear to the shoemaker's mind, because his employer, by instructions given beforehand, has completely cut himself off from all ground of complaint. "The shoe is made

exactly to the foot," says the shoemaker, and his victim also readily consoles himself with this reflection, and attributes his long-endured infirmity of feet to every cause but the right one. In this expedient there is also, however, much deception, the very foundation on which it rests being quite untenable. It proceeds on the principle that there are primary differences in the structure of feet; this is an error. All feet are perfectly alike in the principles of their mechanical construction, and the only differences in our healthy feet are those arising from varying length and breadth. In the original form of the foot we never meet with those essential differences, designated by shoemakers straight or bent feet, and still less with such variations as arise from the position in which the great toe lies, or from the thickness of the *ball* at its root. Variations of the latter description only indicate how far the form of the foot has passed towards the shape of the shoe; in other words, to what extent the foot has become deformed by shoes worn at a former period.

For healthy feet, therefore, a drawing is superfluous; it is sufficient to have the length and breadth, and—most important of all—a knowledge of the structure of the healthy foot. To the management of feet already distorted I shall return hereafter.

The true form of the foot, moreover, is never attained by such a drawing. It is usually taken from a foot

enveloped in a tightly fitting stocking, and in this case the direction of the great toe is always oblique, because, from the constant pressure of the shoe, this obliquity comes to be assumed so readily, that the very moderate force exerted by a stocking is quite sufficient to bring it about. The foot is consequently drawn with the toes unnaturally pressed together. A drawing taken from the nude, with a knowledge of the anatomy of the foot, is the only one that will give the correct form of the sole of any foot.

But while a drawing of the naked foot is unnecessary, it might still be of some advantage, and might be used to some purpose by a shoemaker who knows and is willing to apply the true principles on which a sole ought to be constructed, for it would do away with the necessity of sundry individual measurements, and give him exact copies of minor defects which must always be taken into consideration in the construction of the shoe. Most shoemakers, however, use such drawings in order to find out how they will be able most conveniently to squeeze the foot into the smallest possible compass; and as long as the shoemaker persists in this endeavour, as long as he recognises as his chief aim the symmetrical squeezing of a foot round the axis of its sole, so long will the most exact copy of a sole afford no guarantee to the employer, that he will get a more comfortable or even a better fitting shoe than that in ordinary use.

The supposed advantages of these drawings rest then, in a great measure, on a delusion; and no less deceptive is the idea that a shoe with a broad sole must fit, simply because the sole is broad.

How a proper Sole may be designed for either Foot.

After what has been stated concerning the structure of the foot, and the evils arising from an improperly-shaped sole, the principles on which a proper one ought to be constructed may be arrived at without difficulty.

The main point to be attended to is, that the great toe shall have its normal position, so that those functions which are proper to it may be called into play in walking. It must, therefore, as has already been pointed out, lie in such a position as that its axis, when carried backwards, shall pass through the centre of the heel. In a straight line, therefore, in which the centre of the heel and the axis of the great toe are included, we have the primary line necessary to designing the entire sole, and a proper sole may now be formed in the following manner:—

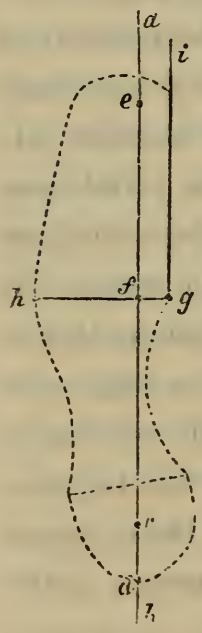

FIG. 21

The length of the foot from the back of the heel to the point of the great toe is laid down in a straight line, *a b*. The half of the breadth of the heel *c d*, should then be marked off on this line, and the centre of

the heel is thus ascertained. The length from the point of the great toe to the point where the hollow of the foot commences, that is to say, to the posterior margin of the ball of the great toe (*e f*), about two-fifths of the whole length of the foot, is now to be measured and marked off in its proper place on the primary straight line, and thus the broadest part of the foot is found. At this place a line should be drawn cutting the longitudinal straight line at right angles, and on this transverse line the greatest breadth of the foot is to be marked, so that just so much of the foot lies on one side of the long line as corresponds to half the breadth of the great toe (*f g*), the rest of the whole breadth of foot falling on the other side (*f h.*) The longitudinal line is now carried a little farther forward, and then *parallel to it* the inner margin (*g i*) of the anterior sole is to be drawn, and for this purpose we begin at the inner termination of the transverse line which indicates the greatest breadth of the foot.

All the points essential to the construction of a proper sole have thus been obtained, namely, the inner margin of the anterior sole, the posterior boundary of the heel, and the greatest projection of the little toe. Around these points a sole may readily be constructed, as may be seen from the annexed drawing (Fig. 21), in which the outlines of the sole are filled up with dotted lines. To a shoemaker of good taste, it will not be at all difficult to infuse into the design a certain amount of elegance. By way of

example I submit the adjoining Figure (22), the outline of a sole designed from the points just indicated by Mr. Weber, a shoemaker in Zurich ; and in order to show the difference between a sole of this kind and one of the usual construction, I add the outline of one of the latter description (Fig. 23), which was cut out by the same

Fig. 22.

Fig. 23.

artiste for the same foot, the deviations of the proper sole being distinguished by dotted lines.

In designing a sole, a drawing of the sole of the foot may be very useful to a shoemaker who knows and is willing to apply the true principles of his art, as he will thereby be saved the trouble of taking numerous individual measurements.

To recapitulate what we have already said: A sole is of the proper construction when a line (see Fig. 22 *c d*), drawn at half the breadth of the great toe distant from, and parallel to, the inner margin of that toe, shall, when carried backwards, pass through the centre of the heel. In the usual form of a sole this line passes out of the inner margin of the heel (see Fig. 7). If, then, the preservation of the primary straight line is, as has been already shown, the principal point in the formation of a proper sole, it

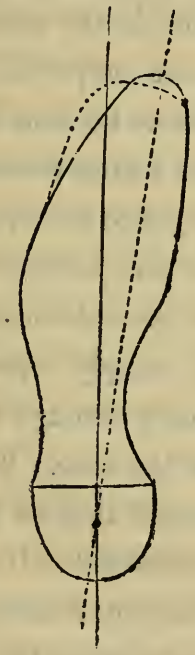

Fig. 24.

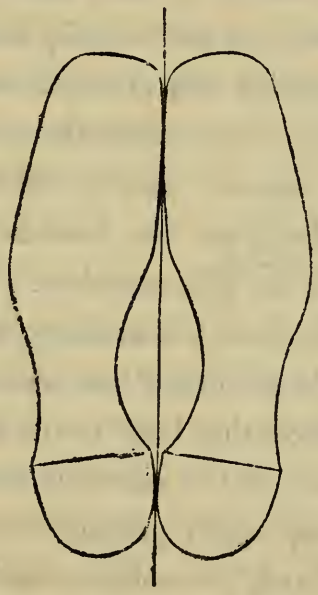

Fig. 25.

follows, that if it be thought desirable to have pointed shoes, the pointing must be effected from the outer side, as indicated in the annexed Figure (24).

In a pair of shoes made on these principles, placed side

by side with the heels in contact, the inner margins of the front part of the foot are also brought close together. (Fig. 25.)

How Soles are to be constructed for Feet in which the Great Toe has already been pressed obliquely outwards.

We have just seen how the sole should be constructed for feet not very decidedly distorted by the ordinary form of sole, that is, in those cases in which in the naked foot the great toe still readily assumes its proper direction. The question now arises, How is this to be done for feet in which, when naked, the toe retains a false direction?

The answer is simple: The sole ought to be cut exactly as if the great toe were in its proper position. The grounds for this are clear. For, if the sole be made to suit the foot, the ordinary shape is simply reproduced, since the deformity has arisen precisely through the foot accommodating itself to the shape of the shoe. The continuation of the injurious effects would thus be insured, and they might perhaps even be increased. If, on the other hand, the sole be made of the proper shape, it becomes possible for the great toe to assume its normal position, and thus restore the foot to its true form. When the projection at the root of the great toe is already considerable, the breadth of the shoe might even be somewhat lessened at this point, in order that a gentle pressure

on this region might support the great toe in its change to the right direction.

Whether, and how far, this expedient might be advisable in very well-marked distortions and swellings ought, in every individual case, to be decided by an experienced surgeon.

I must now explain more particularly how the sole is to be constructed in such a case of permanent obliquity of the great toe, because a certain point must here be carefully attended to.

That is to say, the length of the foot is not to be taken in one measurement, for if so taken, the sole will be inevitably too short, but it must be taken in two parts, the first being the length from the heel to the joint at the root of the great toe, and the second the length from this joint to the point of the great toe. These two measurements must then be added to each other and laid down in a straight line, and the result will be the primary longitudinal line of the foot, which is employed in the further modelling of the sole exactly as directed in the previous section. Suppose, for example, that the sole of the foot for which a shoe is to be made has the form of the adjoining Figure, the length *b a* is to be measured first, and then that of

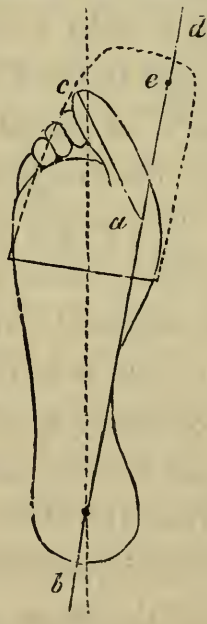

Fig. 26.

a c; the latter should then be carried out in continuation (*a d*) of the line *b a* which will now extend to *e*, and *b e* will then represent the true length of the foot in question.

Are High Heels of any Use?

It is usual in all shoes of even moderate strength to make the heel a little higher by means of what is called a *heel-piece.*

These heel-pieces are generally of some little use, especially in dirty weather, and we cannot wholly deny their right to existence. But, at the same time, they ought to be as low as possible, and heels an inch thick, as is at present very commonly the case, have very serious disadvantages indeed.

The weight of the body is by this means thrown in a disproportionate ratio on the toes, the joints of which are consequently overstrained. Moreover, with a high heel the sole is so oblique in its direction that the foot must constantly be gliding forwards and forcibly pressing the toes into the point of the shoe. The toes therefore, even when the shoe is sufficiently long, are subjected to the same injuries and disfigurations as if it were too short, and the effects are doubly hurtful, when the form of the sole is also incorrect.

High heels, especially if they are also very small, are

peculiarly liable to wear obliquely, and so the shoe gets trodden on one side; they must therefore be peculiarly favourable to the origin of flat-foot.

High and small heels are therefore quite unsuitable. The heel-piece ought to be as low and broad as possible.

The Upper Leather—Boots or Shoes?

With regard to the upper leather, there is on the whole little to be said, since its shape is in a great measure determined by that of the sole, so that with a properly constructed sole the upper leather must also be essentially correct. It need only be observed, that the material should be as pliant as possible, and that it is well adapted to its purpose, when sufficient width is allowed over the toes to enable them to move freely in walking and without constant pressure being exerted on their first joints.

[Especial care must therefore be taken to have the upper leather so wide at the inner margin of the foot as to admit of the great toe resuming its natural position, which is now made possible by the shape of the sole.]*

We now come to another important question, namely, where and how is the fastening of the shoe, or boot, to be effected?

* This sentence is not in the original, and is here inserted by desire of the author.

Very light low shoes, such as dancing shoes and slippers, the upper leathers of which are alone sufficient to keep them firmly on the foot, do no harm by the mode of their fastenings, but it is insufficient, and a more efficient contrivance is required for the ordinary boot or shoe.

The boot is fastened by firmly encircling the foot at the instep. The whole foot is so wedged in between upper leather and sole, that, as is well known, the pulling off of a boot very frequently necessitates the use of a boot-jack.

It is impossible that the foot can be thus tightly clasped without producing a constant pressure on the instep. What then are the consequences of this?

We have already seen that the foot forms an arch, the efficiency of which in a special manner depends on the tensity of its ligaments being maintained. If, then, an unnatural and flattening pressure be constantly exercised on this arch, the binding ligaments get slackened and the arch falls down; and a broken-down arch, as we have already seen, causes flat-foot. The pressure of the upper leather on the instep must therefore, and particularly in the case of narrow boots, favour the origin of this deformity. The same cause must further interfere with locomotion, for at every step the increased arching of the instep, which takes place the moment that the foot is set to the ground, is resisted by the upper leather, and an injurious influence is thus exercised on the action of some

of the muscles used in walking, and which run from the anterior aspect of the lower leg to the back of the foot.

A boot is thus by the nature of its fastenings rendered a very unsuitable covering for the foot. When we consider, then, how very generally boots are worn, and worn, as a rule, with very high, small heels and badly-shaped soles, we need feel no surprise that flat-foot, bent-up toes, "chilblains," grown-in nails, corns, bunions, etc., are so common.

Notwithstanding this fault on the part of boots, we must bear in mind that this kind of covering is almost indispensable for wading through water and walking in snow. Only let care be always taken that boots made for such purposes be not too closely fitting over the instep.

Shoes or half-boots, in which the fastening is effected by means of laces, are better than boots, inasmuch as a lace can never be pulled so tight as the upper leather may be, for it often takes the whole strength and weight of a man's body to enable him to squeeze his foot into a boot.

The best kind of fastening, however, is that which is carried somewhat above the ankles, especially if it be possessed of a certain amount of elasticity. The fastenings of half-boots, by means of pieces of elastic let into them, are therefore very suitable when not too tight. With such a fastening the arch of the foot is in no way impeded in its action, and the movements of walking are thus effected in the easiest and most unconstrained manner possible.

[It must, however, by no means be inferred, that the upper leather should not fit the foot with accuracy. It is absolutely necessary indeed that it should do so for the protection of the toes in going down hill. And what has just been said must only be considered as a warning against the *too* tight, and consequently hurtful, closing so common in boots.]*

Answers to Objections.

Various objections will doubtless be made to the kind of sole proposed in these pages, and the curved form will be especially found fault with, for it will be said that one cannot be elegantly *chaussé* in such shoes.

Objections of this kind indeed have been already suggested.

To such remarks I have to reply, that the objector must first define his notion of the word *elegant.*

One set of people consider *elegant* and *fashionable* as equivalents. I need only remind these, that *Fashion* has already had many changes, and that she brings about new ones every day. It is perfectly possible, then, that she may one day take up the proposed form, and from that

* This paragraph also is added in this translation at the request of the author.

moment it will become elegant. A shape may come into fashion—and be thought elegant too—provided only a considerable number of persons approve of and adopt it.

Others say such a shoe cannot be elegant, because the feet appear to be too much turned inwards. This idea is a pure hallucination: the proposed form of shoe admits of the foot having its own proper shape, while in reality the ordinary form frequently renders the actual turning in of the foot quite necessary for the relief of pain experienced at the root of the great toe.

Others again, taking their stand on a *sense of the beautiful*, declare the curved sole anything but beautiful, and therefore inelegant. I would only ask such people if they consider a naturally-formed foot less beautiful than a crippled one, and if they consider a shoe that always sits well less agreeable to look at than one trodden to one side.

Another set object to it as being too conspicuous. To these I can only say, that anything will cease to be conspicuous when it comes into general use. The proposed form, however, is not after all so very remarkable in appearance, several persons having already adopted it without attracting undue attention. On the other hand, a crippled foot *is* conspicuous, and very unpleasantly conspicuous too.

But even if the proposed form of shoe be somewhat peculiar, as a set-off it has the advantage of always sitting

well, of affording the greatest possible comfort in walking, of keeping the foot in good shape and condition, and even of giving a chance of recovery to an already injured foot. And in deciding for or against it, these advantages must, among other things, be taken into account.

EXPLANATION OF WOODCUTS.

Fig.	Page	
1	19	Bony framework of a healthy foot, seen from above,—*a a*, metatarsal bones,—*b*, astragalus,—*c c*, phalanges of toes,—*d d*, the tarsus of which the astragalus forms a part.
2	19	The inner aspect of the foot, showing the arched construction of the whole foot,—*a*, head of metatarsal bone of great toe,—*b*, calcaneum,—*c*, astragalus.
3	21	View of a sole as yet in its natural state.
4	21	Sole of the foot of a child two years old. (In both of these Figures (3 and 4) the continuation of the axis of the great toe is seen to pass through the centre of the heel.)
5	23	A symmetrical (straight) sole, like those usually made for ladies' shoes.
6	23	A sole of the same kind for a man's foot.
7	23	An unsymmetrical sole (made to fit one foot only) of the ordinary make,—*c d*, the line in which the axis of the great toe lies in a sole of this kind.
8	23	The two outlines (Figs. 6 and 7) laid on one another, showing that the only difference between these two soles is in the direction of the "*waist*" between the heel and the anterior part of the foot.
9	25	Sole of the foot of a girl twenty-two years old, distorted by the pressure of the shoe, but otherwise healthy.
10	25	The same sole with the outline of a *straight* sole laid over it, showing how such distortions are produced by the form of the foot accommodating itself to that of the shoe.

Fig.	Page	
11	25	View of the skeleton of a foot so deformed, from above. The joints of the toes look shorter here than in the healthy foot (Fig. 1), because, on account of the toes being curved, they are apparently diminished in length.
12	26	Sole of a woman about twenty; the second toe is pressed upwards and is therefore not visible.
13	26	Sole of the foot of a girl somewhat younger; the second toe is not seen here either, and the rest of the toes are also pressed into an opposite and wrong direction.
14	26	Apparently healthy sole of a young man nineteen years of age, in which, however, a false direction of the great toe may be observed.
		Note.—The two Figures 12 and 13, as well as Figures 3 and 9, I owe to Dr. Albrecht Claus, who was kind enough to sketch them from bodies lately coming before him as anatomical subjects; I have to thank the same gentleman for the drawings of Figures 4 and 14. It would have been easy to increase very considerably the number and varieties of examples of deformities
15	31	The nail of the great toe in its healthy state. The dotted line shows the extent to which the nail is connected under the skin.
16	31	The nail of the great toe pushed obliquely on one side,—*a*, inflamed margin of the fold of skin pressed outwards,—*b* in this and the immediately preceding Figure is explained in the text.
17	32	Transverse section through the distal phalanx of the great toe with a healthy nail.
18	32	Transverse section of the anterior joint of the great toe with the outer edge of the nail bent up, ("growing-in nail.")
19	34	Bones of a foot in which the joint at the root of the great toe is very much distorted inwards, inflammatory exudations forming bony prominences are also apparent; seen from above.
20	37	Sole of a shoe unusually broad in the fore part, showing that in a sole of this kind also the great toe has a false position, that is to say, in *c d* instead of *a b*.
21	40	Design for the construction of a proper sole. Explanation in text.

Fig.	Page	
22	42	The proper sole for a shoe, indicating the line in which the great toe lies,—*c d*. The line marked *a b* is that round which the shoe is constructed in the usual method. (Compare Figures 5, 6, and 7.)
23	42	The proper sole (Fig. 22) laid, for the sake of comparison, on the symmetrical sole of the ordinary shape (Fig. 7).
24	43	The proper sole pointed at the toes.
25	43	Right and left soles of the proper construction placed side by side.
26	45	Method of constructing the proper kind of soles in cases where the great toe has been pressed obliquely out of its true position. Description in text.